FOM-E3, FOM-T3

E3/T3 Fiber Optic Modem

Version 1.0

RAD
data communications
The Access Company

FOM-E3, FOM-T3

E3/T3 Fiber Optic Modem

Version 1.0

Installation and Operation Manual

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RAD warrants to DISTRIBUTOR that the hardware in the FOM-E3, FOM-T3 to be delivered hereunder shall be free of defects in material and workmanship under normal use and service for a period of twelve (12) months following the date of shipment to DISTRIBUTOR.

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This Agreement shall be construed and governed in accordance with the laws of the State of Israel.

Product Disposal

To facilitate the reuse, recycling and other forms of recovery of waste equipment in protecting the environment, the owner of this RAD product is required to refrain from disposing of this product as unsorted municipal waste at the end of its life cycle. Upon termination of the unit's use, customers should provide for its collection for reuse, recycling or other form of environmentally conscientious disposal.

General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

Safety Symbols

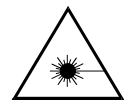|	
⚠ **Warning**	This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.
⚡	Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.
⏚	Protective ground: the marked lug or terminal should be connected to the building protective ground bus.
☀ **Warning**	Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached. Please observe the following precautions: - Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter. - Do not attempt to adjust the laser drive current. - Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam. - The use of optical devices with the equipment will increase eye hazard. - Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure. ATTENTION: The laser beam may be invisible!

In some cases, the users may insert their own SFP laser transceivers into the product. Users are alerted that RAD cannot be held responsible for any damage that may result if non-compliant transceivers are used. In particular, users are warned to use only agency approved products that comply with the local laser safety regulations for Class 1 laser products.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective ground terminal. If a ground lug is provided on the product, it should be connected to the protective ground at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in grounded racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Some products may have panels secured by thumbscrews with a slotted head. These panels may cover hazardous circuits or parts, such as power supplies. These thumbscrews should therefore always be tightened securely with a screwdriver after both initial installation and subsequent access to the panels.

Connecting AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A (20A for USA and Canada). The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A (40A for USA and Canada).

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

In cases when the power distribution system is IT type, the switch must disconnect both poles simultaneously.

Connecting DC Power

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC power systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

Make sure that the DC power supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A (20A for USA and Canada). The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A (40A for USA and Canada).

Before connecting the DC supply wires, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

If the DC power supply is floating, the switch must disconnect both poles simultaneously.

Connecting Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The grounding and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution	To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention	Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good ground connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the ground bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning	This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.
Avertissement	Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.
Achtung	Das vorliegende Gerät fällt unter die Funkstörgrenzwertklasse A. In Wohngebieten können beim Betrieb dieses Gerätes Rundfunkströrungen auftreten, für deren Behebung der Benutzer verantwortlich ist.

Mise au rebut du produit

Afin de faciliter la réutilisation, le recyclage ainsi que d'autres formes de récupération d'équipement mis au rebut dans le cadre de la protection de l'environnement, il est demandé au propriétaire de ce produit RAD de ne pas mettre ce dernier au rebut en tant que déchet municipal non trié, une fois que le produit est arrivé en fin de cycle de vie. Le client devrait proposer des solutions de réutilisation, de recyclage ou toute autre forme de mise au rebut de cette unité dans un esprit de protection de l'environnement, lorsqu'il aura fini de l'utiliser.

Instructions générales de sécurité

Les instructions suivantes servent de guide général d'installation et d'opération sécurisées des produits de télécommunications. Des instructions supplémentaires sont éventuellement indiquées dans le manuel.

Symboles de sécurité

Avertissement

Ce symbole peut apparaitre sur l'équipement ou dans le texte. Il indique des risques potentiels de sécurité pour l'opérateur ou le personnel de service, quant à l'opération du produit ou à sa maintenance.

Danger de choc électrique ! Evitez tout contact avec la surface marquée tant que le produit est sous tension ou connecté à des lignes externes de télécommunications.

Mise à la terre de protection : la cosse ou la borne marquée devrait être connectée à la prise de terre de protection du bâtiment.
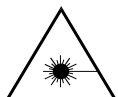
Avertissement

Certains produits peuvent être équipés d'une diode laser. Dans de tels cas, une étiquette indiquant la classe laser ainsi que d'autres avertissements, le cas échéant, sera jointe près du transmetteur optique. Le symbole d'avertissement laser peut aussi être joint.

Veuillez observer les précautions suivantes :

- Avant la mise en marche de l'équipement, assurez-vous que le câble de fibre optique est intact et qu'il est connecté au transmetteur.
- Ne tentez pas d'ajuster le courant de la commande laser.
- N'utilisez pas des câbles ou connecteurs de fibre optique cassés ou sans terminaison et n'observez pas directement un rayon laser.
- L'usage de périphériques optiques avec l'équipement augmentera le risque pour les yeux.
- L'usage de contrôles, ajustages ou procédures autres que celles spécifiées ici pourrait résulter en une dangereuse exposition aux radiations.

ATTENTION : Le rayon laser peut être invisible !

Les utilisateurs pourront, dans certains cas, insérer leurs propres émetteurs-récepteurs Laser SFP dans le produit. Les utilisateurs sont avertis que RAD ne pourra pas être tenue responsable de tout dommage pouvant résulter de l'utilisation d'émetteurs-récepteurs non conformes. Plus particulièrement, les utilisateurs sont avertis de n'utiliser que des produits approuvés par l'agence et conformes à la réglementation locale de sécurité laser pour les produits laser de classe 1.

Respectez toujours les précautions standards de sécurité durant l'installation, l'opération et la maintenance de ce produit. Seul le personnel de service qualifié et autorisé devrait effectuer l'ajustage, la maintenance ou les réparations de ce produit. Aucune opération d'installation, d'ajustage, de maintenance ou de réparation ne devrait être effectuée par l'opérateur ou l'utilisateur.

Manipuler des produits sous tension

Règles générales de sécurité

Ne pas toucher ou altérer l'alimentation en courant lorsque le câble d'alimentation est branché. Des tensions de lignes peuvent être présentes dans certains produits, même lorsque le commutateur (s'il est installé) est en position OFF ou si le fusible est rompu. Pour les produits alimentés par CC, les niveaux de tension ne sont généralement pas dangereux mais des risques de courant peuvent toujours exister.

Avant de travailler sur un équipement connecté aux lignes de tension ou de télécommunications, retirez vos bijoux ou tout autre objet métallique pouvant venir en contact avec les pièces sous tension.

Sauf s'il en est autrement indiqué, tous les produits sont destinés à être mis à la terre durant l'usage normal. La mise à la terre est fournie par la connexion de la fiche principale à une prise murale équipée d'une borne protectrice de mise à la terre. Si une cosse de mise à la terre est fournie avec le produit, elle devrait être connectée à tout moment à une mise à la terre de protection par un conducteur de diamètre 18 AWG ou plus. L'équipement monté en châssis ne devrait être monté que sur des châssis et dans des armoires mises à la terre.

Branchez toujours la mise à la terre en premier et débranchez-la en dernier. Ne branchez pas des câbles de télécommunications à un équipement qui n'est pas mis à la terre. Assurez-vous que tous les autres câbles sont débranchés avant de déconnecter la mise à la terre.

Connexion au courant du secteur

Assurez-vous que l'installation électrique est conforme à la réglementation locale.

Branchez toujours la fiche de secteur à une prise murale équipée d'une borne protectrice de mise à la terre.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A (20A aux Etats-Unis et Canada). Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A (40A aux Etats-Unis et Canada).

Branchez toujours le câble d'alimentation en premier à l'équipement puis à la prise murale. Si un commutateur est fourni avec l'équipement, fixez-le en position OFF. Si le câble d'alimentation ne peut pas être facilement débranché en cas d'urgence, assurez-vous qu'un coupe-circuit ou un disjoncteur d'urgence facilement accessible est installé dans l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si le système de distribution de courant est de type IT.

Connexion d'alimentation CC

Sauf s'il en est autrement spécifié dans le manuel, l'entrée CC de l'équipement est flottante par rapport à la mise à la terre. Tout pôle doit être mis à la terre en externe.

A cause de la capacité de courant des systèmes à alimentation CC, des précautions devraient être prises lors de la connexion de l'alimentation CC pour éviter des courts-circuits et des risques d'incendie.

Assurez-vous que l'alimentation CC est isolée de toute source de courant CA (secteur) et que l'installation est conforme à la réglementation locale.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A (20A aux Etats-Unis et Canada). Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A (40A aux Etats-Unis et Canada).

Avant la connexion des câbles d'alimentation en courant CC, assurez-vous que le circuit CC n'est pas sous tension. Localisez le coupe-circuit dans le tableau desservant l'équipement et fixez-le en position OFF. Lors de la connexion de câbles d'alimentation CC, connectez d'abord le conducteur de mise à la terre à la borne correspondante, puis le pôle positif et en dernier, le pôle négatif. Remettez le coupe-circuit en position ON.

Un disjoncteur facilement accessible, adapté et approuvé devrait être intégré à l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si l'alimentation en courant CC est flottante.

Declaration of Conformity

Manufacturer's Name: RAD Data Communications Ltd.

Manufacturer's Address: 24 Raoul Wallenberg St., Tel Aviv 69719, Israel

declares that the product:

Product Name: FOM-E3, FOM-T3

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022:1998 + A1:2000, A2:2003	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
	EN 55024:1998 + A1:2001, A2:2003	Information technology equipment – Immunity characteristics – Limits and methods of measurement.
Safety:	EN 60950-1:2001	Information technology equipment – Safety – Part 1: General requirements.

Supplementary Information:

The products herewith comply with the requirements of the EMC Directive 89/336/EEC, the Low Voltage Directive 73/23/EEC and the R&TTE Directive 99/5/EC for wired equipment. The products were tested in a typical configuration.

Tel Aviv, 11 August 2005

Haim Karshen

VP Quality

European Contact: RAD Data Communications GmbH, Otto-Hahn-Str. 28-30, 85521 Ottobrunn-Riemerling, Germany

Quick Start Guide

If you are familiar with FOM-E3 and FOM-T3 fiber optic modems, use this guide to prepare the units for operation.

1.   Installing FOM-E3 and FOM-T3

Open the FOM-E3 and FOM-T3 case by releasing the two rear panel screws and sliding out the PCB interior of the unit.

Setting the Main Board Jumpers

Set the main board jumper according to the following table:

Jumper	Description	Values (factory seting in bold)
AIS, JP5	Controls the AIS transmission to the electrical or optical interface, when a minor alarm is detected	**ON** – AIS is transmitted OFF – AIS is not transmitted

Selecting the E3/T3 Cable Length

Refer to the tables below and select the cable length, depending on your unit's interface type: E3 or T3.

Jumper	Description	Values*
E3 Cable Length Jumper, JP2	Selects the E3 cable length	**Pins 1, 2** – Cable length is from 0 to 300 ft Pins 2, 3 – Cable length is more than 300 ft

Note: The maximum possible cable length complies with ITU-T G.703.

T3 Cable Length	Jumper Positions		
	JP1	**JP2**	**JP3**
0 ft – 225 ft	**Pins 2, 3**	**Pins 1, 2**	**Pins 2, 3**
225 ft – 450 ft	Pins 1, 2	Pins 1, 2	Pins 1, 2
More than 450 ft	Pins 1, 2	Pins 2, 3	Pins 1, 2

Note: The maximum cable length complies with ITU-T G.703.

* Factory settings are shown in bold.

Connecting the Cables

➤ **To connect the cables:**

1. Connect the E3 or T3 electrical interface.

2. Connect the fiber optic interface.

3. Connect the power cable (first to the modem, then to the mains supply).

   Operation starts when the power is applied to the rear panel power connector.

2.   Operating FOM-E3 and FOM-T3

1. Check that the TEST switch is set to the NORM position.

2. Verify LED status. All the LED indicators should be OFF, except for the PWR indicator.

3. If there is an indication of a malfunction or fault, run a diagnostic test.

Contents

Chapter 1

Introduction

1.1   Overview

FOM-E3 and FOM-T3 are fiber optic modems for transmission of E3 (34.368 Mbps) or T3 (44.736 Mbps) over multimode- or single-mode fiber optic media.

The units are transparent to framing, and can transmit data using any framing pattern with HDB3 or B3ZS coded signals.

The electrical signal is converted into an optical signal using an infrared light emitting diode or laser diode transmitter. At the opposite end of the fiber, the optical signal is converted back into an electrical signal and amplified to the required level. FOM-E3 and FOM-T3 utilize a Phase Locked Loop (PLL) circuit to recover data and clocking from the signal and provide electrical interface of two BNC connectors with 75Ω impedance.

Diagnostic and alarm features include LED status indicators, V.54 loopbacks activated from the front panel, and an alarm relay port for reporting the system status.

When the FOM-E3 or FOM-T3 detects electrical interface levels below G.703 electrical levels, the modem transmits an "all 1s" signal (AIS) to the optical interface. When an "all 1s" (AIS) signal is detected at the optical or electrical interface, the modem converts this signal transparently and alerts the user via front panel LEDs and the supervisory port.

The electrical interface meets requirements of ITU G.703, G.921 and G.935 standards for E3 and T3.

Versions

Electrical Interface

The units are available in the following electrical interface versions:

- FOM-E3: E3 electrical interface fully compatible with the applicable ITU-T standards. HDB3 line coding is used.

- FOM-T3: T3 electrical interface, fully compatible with requirements of ITU-T G.703 and G.824 standards. B3ZS line coding is used.

Fiber Optic Interface

FOM-E3 and FOM-T3 supports different fiber optic interfaces, as detailed in *Table* 1-1.

Power Supply

- AC source: 100 to 240 VAC

- DC source: 40 to 72 VDC

Application

In the application illustrated in *Figure 1-1*, each FOM-E3 or FOM-T3 receives E3 or T3 signals, which are equalized to overcome electrical link distortion. FOM-E3 or FOM-T3 then converts the E3 or T3 signals into an optical signal. The optical signal is coupled to the fiber optic media and transmitted via the optical link to the remote unit. A high sensitivity pre-amplifier and an AGC (Automatic Gain Control) circuit enable the remote unit to receive the optical signal. The output of the receiver is then applied to the clock recovery and data regeneration circuit, which in turn applies it to the electrical interface driving circuit.
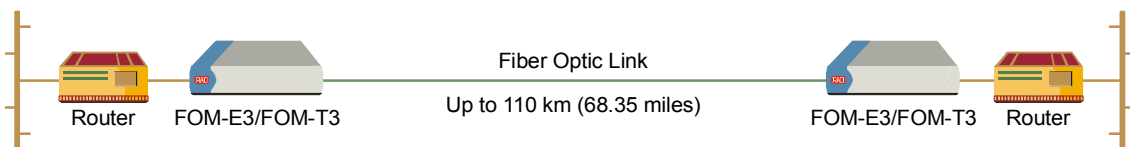

Router   FOM-E3/FOM-T3   Fiber Optic Link
Up to 110 km (68.35 miles)   FOM-E3/FOM-T3   Router

Figure 1-1. FOM-E3, FOM-T3, Typical Application

Features

- Extends the range of E3, T3 signals over fiber optic cable up to 110 km (68.35 miles)

- Transparent to E3, T3 signals

- Conforms with all relevant ITU series standards

- Supports multimode- or single-mode fiber

- Extends distances with laser diode option, including long haul and WDM laser option.

FOM-E3 and FOM-T3 also feature:

- LED status indicators

- V.54 loopbacks activated from the front panel

- An alarm relay port for reporting the status of the system.

FOM-E3 and FOM-T3 operates with several different grades and sizes of fiber optic cable and provide the user with:

- Extended high-rate range transmission

- Immunity to electrical interference such as EMI, RFI, spikes, and differential ground loops

- Secure data transfer (transmitted information cannot be tapped)

- Protection from sparks and lightning

- Secure link in hazardous or hostile environment.

Table 1-1. FOM-E3 and FOM-T3 Fiber Optic Interface Options

Wavelength [nm]	Fiber Type [µm]	Transmitter Type	Typical Power [dBm]	Receiver Sensitivity [dBm]	Typical Max. Range [km]	[mi]
850	62.5/125 multimode	VCSEL	-15	-34	4.5	2.8
1310	9/125 single mode	Laser	-12	-31	38	23.6
1310	9/125 single mode	Laser (long haul)	-2	-34	70	43.4
1550	9/125 single mode	Laser	-12	-31	68	42.2
1550	9/125 single mode	Laser (long haul)	-1	-34	110	68.3
1310/1550	9/125 single mode	Laser (WDM), SF1, SF2	-12	-30	40	24.8
1310	9/125 single mode	Laser (single strand fiber), SF3	-12	-27	20	12.4

Alarms

When FOM-E3 or FOM-T3 detect that electrical interface levels are below G.703 electrical levels, the modem transmits an "all 1s" signal (AIS) to the optical interface.

When an AIS is detected at the optical or electrical interface, the modem transparently converts the signal and alerts the user via front panel LEDs and the alarm relay port.

Likewise, an alarm is relayed if high bit error rate detected at the fiber optic interface.

1.2   Physical Description

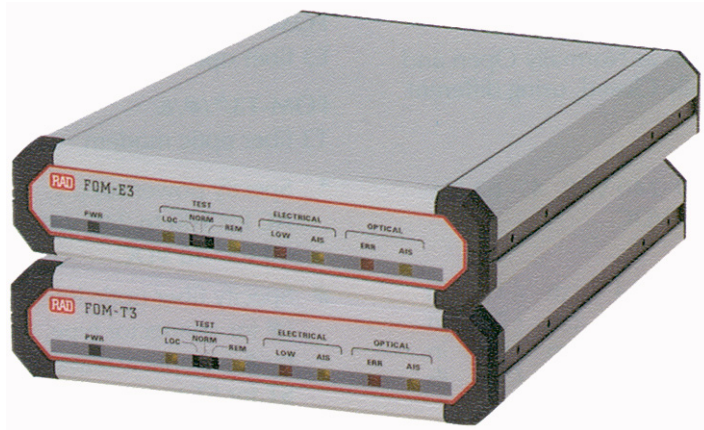*Figure 1-2* illustrates the FOM-E3 and FOM-T3 fiber optic modems.

Figure 1-2. FOM-E3 and FOM-T3, 3D View

The front panels of FOM-E3 and FOM-T3 contain LEDs, which display the power, E3/T3 electrical and fiber optic interface status. The front panel also includes the TEST slide switch for the local and remote loopbacks activation. For details, refer to *Chapter 3.*

The rear panels include the power connector (AC or DC), an E3/T3 electrical interface connectors, fiber optic connectors, and alarm relay connector. The FOM-E3 and FOM-T3 rear panels are described in greater detail in *Chapter 2*.

1.3   Functional Description

This section provides a functional description (*Figure 1-3*) of FOM-E3 and FOM-T3 in the form of block diagrams.
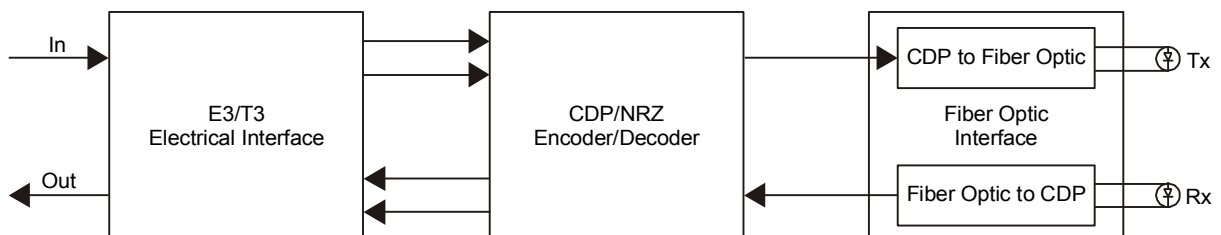

Figure 1-3. FOM-E3, FOM-T3 Block Diagram

FOM-E3 and FOM-T3 have the following signal processing modules:

- Signal conversion
- Data/clock recovery
- Data transfer.

Signal Conversion

An infrared light emitting diode or laser transmitter converts the electrical NRZ signal into an optical CDP signal. At the opposite end of the fiber, the optical signal is converted back into an electrical signal and amplified to the required level.

Data/Clock Recovery

A phase locked loop (PLL) circuit recovers data and clocking from the signal. FOM-E3 and FOM-T3 provide internal selection for the following electrical interfaces:

- E3, 75Ω unbalanced, HDB3 line coding

- T3, 75Ω balanced, B3ZS line coding.

Data Transfer

The optical signal is linked to the fiber-optic media and transmitted to the remote unit. A high-sensitivity pre-amplifier and an automatic gain control (AGC) circuit enable the remote unit to receive the optical signal. The output of the receiver is applied to the clock recovery circuit and the data regeneration circuit, which in turn apply it to the electrical interface driving circuit.

1.4   Technical Specifications

E3/T3 Electrical Interface	*Transmission Rates*	• E3: 34.368 Mbps • T3: 44.736 Mbps
	Impedance	75Ω, unbalanced
	Zero Suppression	• E3: HDB3 • T3: B3ZS
	Connectors	Two BNC connectors
	Applicable Standard	ITU-T G.703
Fiber Optic Interface	*Operating Wavelength*	850 nm, 1300 nm, or 1550 nm (see *Table 1-1*)
	Line Coding	CDP
	Connectors	ST, FC, SC, or SC-APC for SF3 interface
	Output Power	See *Table 1-1*
	Receiver Sensitivity	See *Table 1-1*

	Range	See *Table 1-1*
Diagnostics	*Loopbacks*	• Local loopback (LLB), activated via front panel slide switch
		• Remote loopback (RLB), activated via front panel slide switch
	AIS Signaling	Frequency of ±25 ppm is sent to the electrical interface at the local unit in the event of an optical signal loss. When the electrical interface input level is "LOW", "all 1s" signaling is sent to the optical output
Alarm Relay Port	*Connector*	9-pin, D-type, female
	Alarms	• Major – E3/T3 electrical input becomes lower than G.703 electrical levels, or bit error rate at the fiber optic interface is 10^{-6} or worse
		• Minor – Alarm Indication Signal is received at the E3/T3 electrical or fiber optic interfaces
	Operation	Normally open and normally closed, using different pins
Indicators	*PWR*	Power
	LOC	Local loopback is active
	REM	Remote loopback is active
	ELECTRICAL LOW	E3/T3 electrical input is below G.703
	ELECTRICAL AIS	E3/T3 electrical interface received "All 1s" string
	OPTICAL ERR	Bit error rate of the signal received from the optical interface is 10^{-6} or worse
	OPTICAL AIS	Fiber optic interface received "All 1s" string
Power	*AC Source*	100–240 VAC, 50/60 Hz, 0.2 VA
	DC Source	40–72 VDC, nominal, 0.5A
Physical	*Height*	4.4 cm (1.7 in)
	Width	19.4 cm (7.6 in)
	Depth	24.3 cm (9.6 in)
	Weight	1.4 kg (3.0 lb)
Environment	*Temperature*	0° to 45°C (32° to 113°F)
	Humidity	Up to 90%, non-condensing

Chapter 2

Installation and Setup

This chapter describes installation procedures for the standalone FOM-E3 and FOM-T3 devices.

After installing the unit, refer to *Chapter 3* for the system operation information.

Refer to *Chapter 4* for troubleshooting and diagnostics information.

Warning

Internal settings, adjustment, maintenance, and repairs may be performed only by a skilled technician who is aware of the hazards involved.

Always observe standard safety precautions during installation, operation and maintenance of this product.

Note

Before installing the product, review Handling Energized Products *at the beginning of the manual.*

2.1   Site Requirements and Prerequisites

Install AC-powered FOM-E3 and FOM-T3 units within 1.5m (5 ft) of an easily-accessible grounded AC outlet capable of supplying 100 to 240 VAC.

DC-powered FOM-E3 and FOM-T3 units require a −48 VDC nominal power source, which must be adequately isolated from the mains supply. To prevent a fire hazard, a suitable fuse must be installed in the −48 VDC line.

Allow at least 90 cm (36 in) of frontal clearance for operator access and at least 10 cm (4 in) clearance at the rear of the unit for interface cable connections.

The ambient operating temperature of FOM-E3 and FOM-T3 should be 0° to 45°C (32° to 113°F), at a relative humidity of up to 90%, non-condensing.

2.2   Package Contents

The FOM-E3 or FOM-T3 package includes the following items:

- FOM-E3 or FOM-T3 unit
- Technical Documentation CD
- AC power cord or DC power connector.

2.3   Installation and Setup

FOM-E3 and FOM-T3 are standalone devices intended for tabletop or bench installation. They are delivered completely assembled. No provision is made for bolting the unit on the tabletop.

➤ **To install FOM-E3 or FOM-T3:**

1. Determine the required configuration of FOM-E3 or FOM-T3, according to your application, and set the internal jumpers and switches accordingly.

2. Connect the E3/T3 electrical interface.

3. Connect fiber optic interface.

4. Connect power to the unit.

Setting the Internal Jumpers

This section provides information on the functions of the FOM-E3 and FOM-T3 jumpers, and gives step-by-step instructions for performing the internal settings. The default settings are also listed.

Locations of Jumpers and Switches

FOM-E3 and FOM-T3 include three printed circuit boards (PCBs): the main board, E3/T3 interface board, and fiber optic interface board (see *Figure 2-1*, *Figure 2-2,* and *Figure 2-3*.

The **main board** contains the common signal processing circuits. One jumper, JP5, is provided for user settings.

The **E3/T3 interface boards** provide connection to the E3/T3 links. The E3/T3 boards contain jumpers for selecting the E3/T3 cable length.

The **fiber optic interface board** provides connection to the fiber optic plant. The fiber optic board does not contain any jumpers or switches.

Opening the Case

To reach the internal jumper and switch of FOM-E3 and FOM-T3, open its case.

⚠ *Warning*	**Access to the inside of FOM-E3 and FOM-T3 is permitted only to authorized and qualified service personnel.**
	To avoid accidental electric shock, always disconnect the interface cables and the power cord before removing the units from their casing.
	Line voltages are present inside FOM-E3 and FOM-T3 when they are connected to power and/or to the lines. Moreover, under external fault conditions dangerous voltages may appear on the lines connected to the units.
	Any adjustment, maintenance, and repair of the opened equipment under voltage should be avoided as much as possible and, when absolutely necessary, should be carried out only by a skilled technician who is aware of the hazard involved. Capacitors inside the instruments may still be charged even after the instruments have been disconnected from their power source.

Caution FOM-E3 and FOM-T3 contain components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components. Before moving jumpers, touch the FOM-E3 or FOM-T3 frame.

➤ **To open the FOM-E3 or FOM-T3 case:**

1. Disconnect all the cables connected to FOM-E3 or FOM-T3.

2. Release the two rear panel screws and use them as levers to slide out the PCB interior of the unit.

Setting the Main Board Internal Jumpers

The internal jumper located on the FOM-E3 or FOM-T3 main board is identified in *Figure 2-1*. The jumper settings are described in *Table 2-1*.
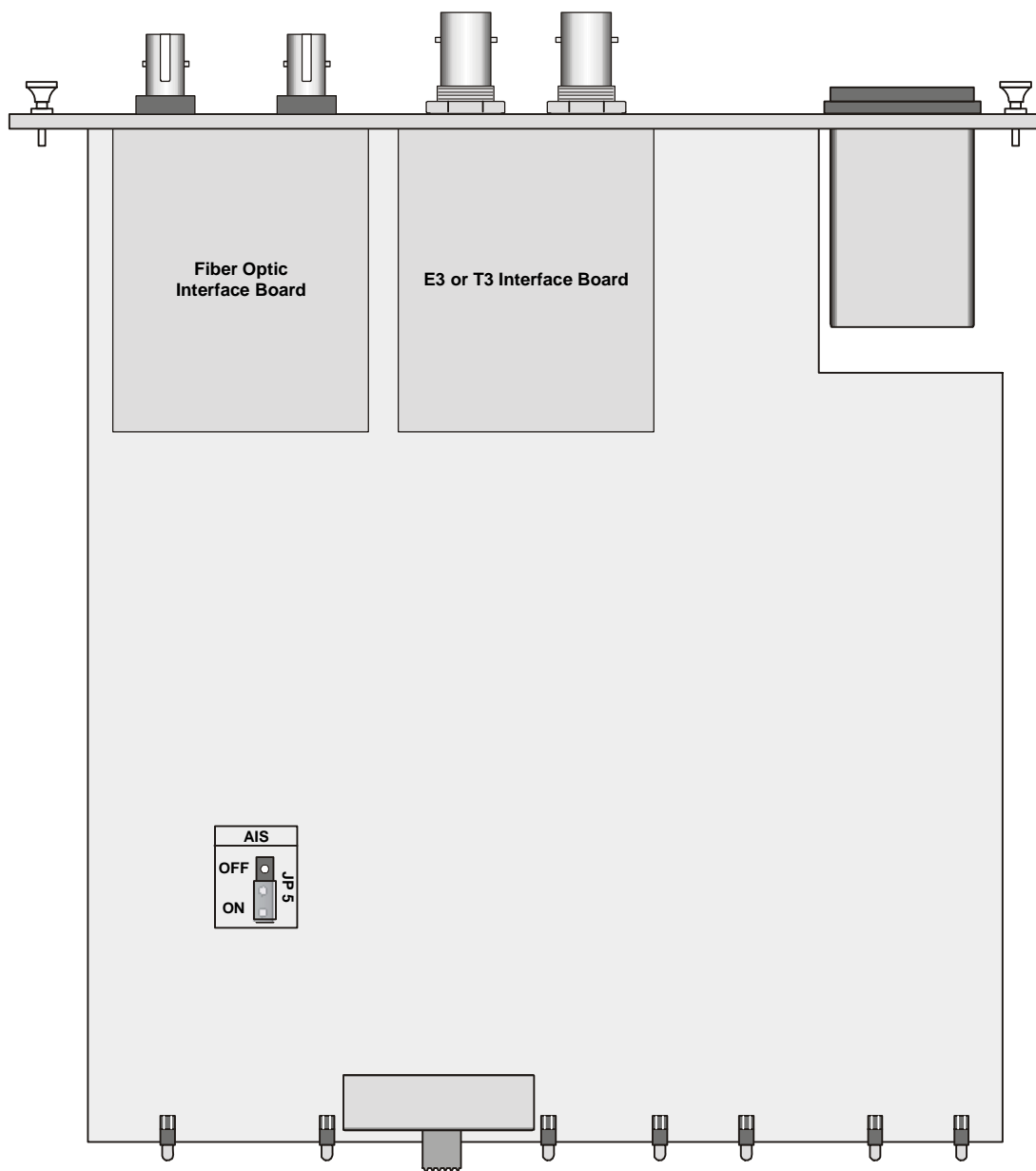
Figure 2-1. Main Board Layout

Table 2-1. Main Board Jumper Settings

Jumper	Description	**Values** (factory setting in bold)
AIS, JP5	Controls the AIS transmission to the electrical or optical interface, when a minor alarm is detected	**ON** – AIS is transmitted OFF – AIS is not transmitted

Setting the E3/T3 Interface Board Jumpers

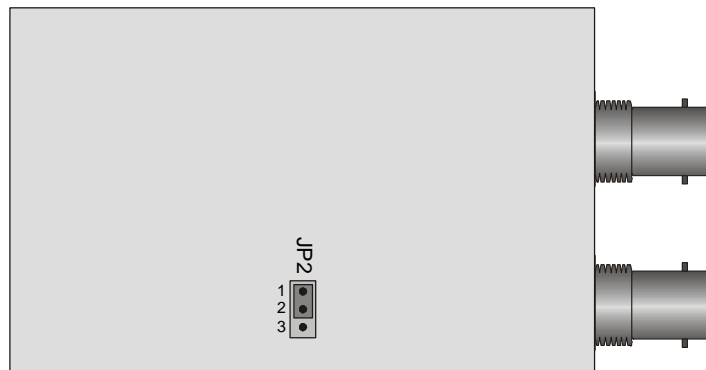Use the JP2 jumper on the E3 interface board to select the E3 cable length (see *Figure 2-2* and *Table 2-2*).

Figure 2-2. E3 Interface Board Layout

Table 2-2. Selecting the E3 Interface Cable

Jumper	Description	**Values** (factory setting in bold)
E3 Cable Length Jumper, JP2	Selects the E3 cable length	**Pins 1, 2** – Cable length is from 0 to 300 ft Pins 2, 3 – Cable length is more than 300 ft
Note: The maximum possible cable length complies with ITU-T G.703.		

Use jumpers JP1, JP2, and JP3 on the T3 interface board to select the T3 cable length (see *Figure 2-1* and *Table 2-3*).
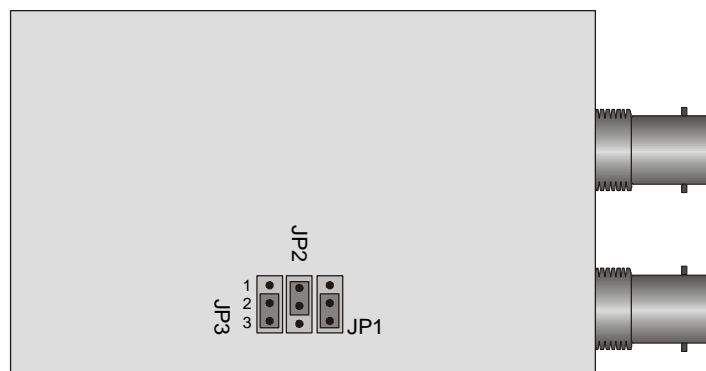

Figure 2-3. T3 Interface Board Layout

Table 2-3. Selecting the T3 Interface Cable

T3 Cable Length	Jumper Positions (factory setting in bold)		
	JP1	JP2	JP3
0 ft – 225 ft	Pins 2, 3	Pins 1, 2	Pins 2, 3
225 ft – 300 ft	Pins 1, 2	Pins 1, 2	Pins 1, 2
More than 300 ft	Pins 1, 2	Pins 2, 3	Pins 1, 2

Note: *The maximum cable length complies with ITU-T G.703.*

Closing the Case

After making the internal settings, close the FOM-E3 and FOM-T3 case.

➤ **To close the FOM-E3 or FOM-T3 case:**

1. Slide the PCB interior back into the case.

2. Screw in the two rear panel screws to fasten the main board in the case.

Connecting the Interfaces

Figure 2-4 shows a typical rear panel of a standard FOM-E3 unit and identifies connector locations for the AC version.
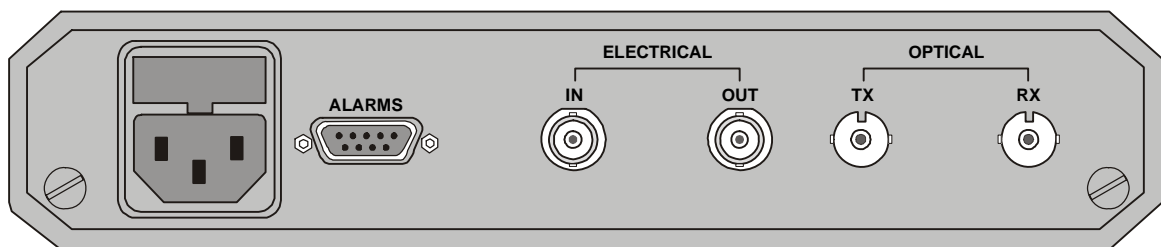

Figure 2-4. FOM-E3 Rear Panel

Connecting the E3/T3 Interface

The E3/T3 interface terminates in two BNC coax connectors, designated IN and OUT.

➤ **To connect E3/T3 interface:**

1. Connect the receive line, using a 75Ω coaxial cable to the BNC connector labeled IN.

2. Connect the transmit line, using a 75Ω coaxial cable to the BNC connector labeled OUT.

Connecting the Fiber Optic Interface

Warning

This module includes Class 1 lasers. For your safety:

* Do not look directly into the optical connectors while the module is operating. Remember that the module starts operating as soon as it is inserted in an operating DXC system.

* Do not attempt to adjust the laser drive current.

The use of optical instruments with this product will increase eye hazard. Laser power up to 1 mW at 1300 nm and 1550 nm could be collected by an optical instrument. The laser beam may be invisible.

Use of controls or adjustment or performing procedures other than those specified herein may result in hazardous radiation exposure.

The fiber optic interface terminates in ST, FC or SC connectors, designated TX and RX.

➤ To connect the fiber optic interface:

1. Remove the protective caps from the connectors and store them in a safe place for later use.

2. Connect the transmit fiber to the connector marked TX and the receive fiber to the connector marked RX.

3. At the remote unit connect the transmit fiber to the connector marked RX and the receive fiber to the connector marked TX.

Connecting the Power

Warning

The units have no power switch. Operation starts when the power is applied to the rear panel POWER connector.

Before switching on this unit and connecting any other cable, the protective earth terminals of this unit must be connected to the protective ground conductor of the mains power cord. If you are using an extension cord (power cable) make sure it is grounded as well.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting of the protective earth terminal can make this unit dangerous. Intentional interruption is prohibited.

For the AC version, make sure that only fuses of the required rating, as marked on the rear panel, are used for replacement. Do not use repaired fuses or short-circuit the fuse holder. Always disconnect the mains cable before removing or replacing the fuse. Whenever it is likely that the fuse protection has been damaged, make the unit inoperative and secure it against unintended operation.

Connecting the AC Power

Note

Before installing the product, review Handling Energized Products *at the beginning of the manual.*

To connect AC power, use the standard 5 ft (1.5m) power cable supplied with the unit. (See *Figure 2-4*).

➤ **To connect AC power:**

- Connect the power cable first to the connector on the FOM-E3 or FOM-T3 rear panel, and then to the mains outlet.

    FOM-E3 and FOM-T3 will be turned on automatically upon connection to the mains.

Connecting the DC Power

➤ **To connect DC power:**

- See the *DC Power Supply Connection Supplement*.

Chapter 3

Operation

3.1 Turning FOM-E3 and FOM-T3 On

FOM-E3 and FOM-T3 operate as soon as they are connected to the power source. The PWR LED turns ON and remains lit as long as the units are connected to the mains.

3.2 Controls and Indicators

Figure 3-1 shows the front panel of FOM-E3. *Table 3-1* lists the functions of the FOM-E3 controls, connectors, and indicators located on the front panel.
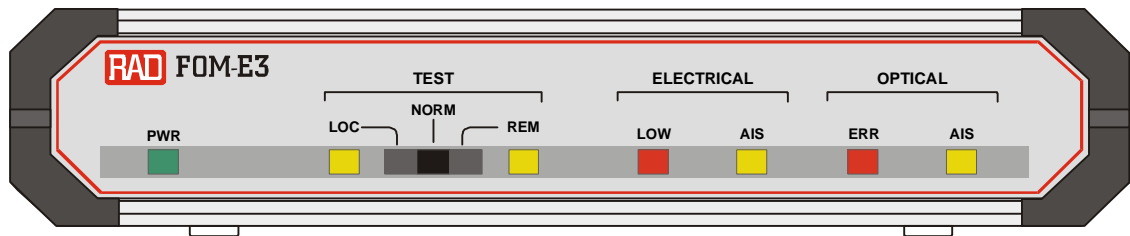

Figure 3-1. FOM-E3 Front Panel

Table 3-1. FOM-E3 and FOM-T3 Controls and Indicators

Name	Type	Function
PWR	Green LED	ON – FOM-E3 and FOM-T3 is powered up
LOC	Yellow LED	ON – A local loopback is active
REM	Yellow LED	ON – A remote loopback is active
TEST	Slide Switch	Controls the local and remote loopbacks
ELECTRICAL LOW	Red LED	ON – E3/T3 electrical input is below G.703
ELECTRICAL AIS	Yellow LED	ON – E3/T3 electrical interface received "All 1s" string
OPTICAL ERR	Red LED	ON – Bit error rate of the signal received from the optical interface is 10^{-6} or worse
OPTICAL AIS	Yellow LED	ON – Fiber optic interface received "All 1s" string

3.3   Normal Operation

During normal operation all indicators should be OFF, except for the PWR
indicator.

Note

*Some of LEDs may turn on upon the FOM-E3 or FOM-T3 power-up, indicating that
other communication equipment is not functioning properly.*

3.4   Turning Off

Turn FOM-E3 and FOM-T3 off by disconnecting the power cord from the mains.

Chapter 4

Diagnostics and Troubleshooting

4.1 Alarm Relay

FOM-E3 and FOM-T3 include a dry contact alarm relay port with a 9-pin connector for sensing major and minor alarms.

- Major alarms are initiated when E3/T3 electrical input becomes lower than G.703 electrical levels, or bit error rate at the fiber optic interface is 10^{-6} or worse.
- Minor alarms occur when an alarm indication signal (AIS) is received at the E3/T3 electrical or fiber optic interfaces.

The dry contact port is normally open or normally closed depending on different pins of the alarm relay port connector (see *Figure 4-1*).
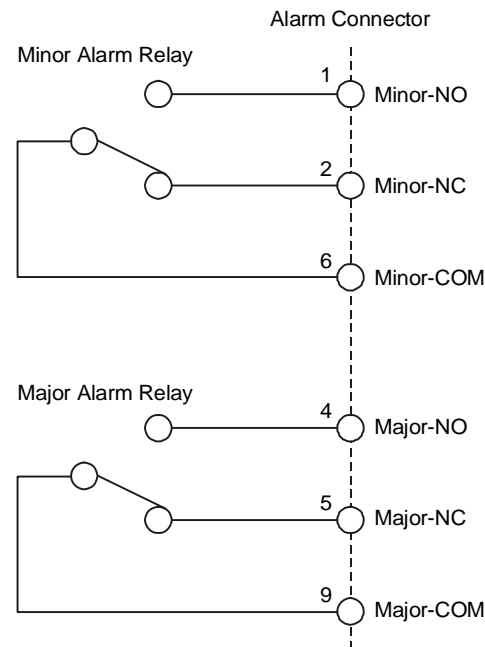
Figure 4-1. Alarm Relay Connector Pinout

Note

The relay positions are shown in the non-energized state (alarm active).

4.2 Diagnostic Loopbacks

Local Loopback (LLB)

FOM-E3 and FOM-T3 support activation of a local loopback, which tests the performance of E3/T3 electrical interface of the local unit and equipment attached to it.

The data received at the E3/T3 electrical interface is looped back to the equipment attached to it (see *Figure 4-2*).
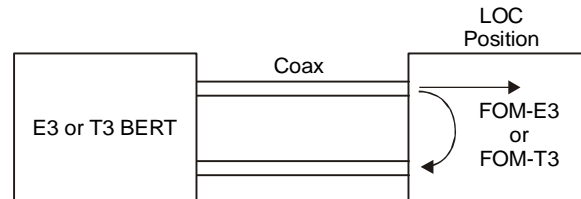

Figure 4-2. Local Loopback

➤ **To activate local loopback:**

- Slide the front panel TEST switch to the LOC position.

   The TEST LOC indicator lights up and remains lit as long as the local loopback is active.

Remote Loopback (RLB)

FOM-E3 and FOM-T3 support activation of a remote loopback, which tests the performance of the local unit's E3/T3 electrical and optical interfaces and the remote unit's optical interface.

The data received at the optical interface of the remote unit is transmitted to the electrical interface and at the same time is looped back to the local unit (see *Figure 4-3*).
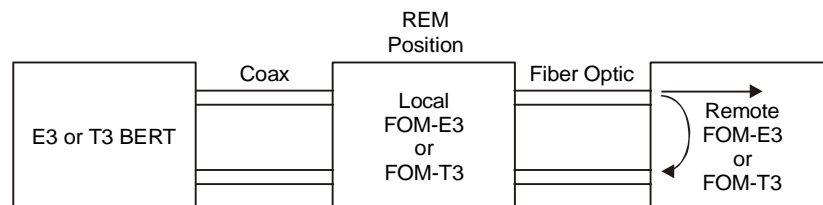

Figure 4-3. Remote Loopback

➤ **To activate remote loopback:**

- Slide the TEST switch of the local FOM-E3 or FOM-T3 to the REM position.

   The TEST LOC indicator of the remote unit lights up and remains lit as long as the remote loopback is active.

4.3   Troubleshooting Instructions

In case a problem occurs, refer to *Table 4-1* for the troubleshooting procedures. Perform the actions listed under *Corrective Measures* in the order given in the table, until the problem is corrected.

Table 4-1. Troubleshooting Chart

Trouble Symptoms	Probable Cause	Corrective Measures
PWR indicator is OFF	No AC power	• Verify that the power outlet is providing the required power. • Ensure that the both ends of the power cable are connected properly.
	Blown fuse	Replace with a fuse of correct rating
ELECTRICAL LOW indicator is ON	One of the E3/T3 coaxial cables is defective or disconnected	Ensure that both ends of the E3/T3 coaxial cables are connected correctly and that the cables function properly.
	Attached equipment outputs do no comply with G.703 electrical levels	Check that the output levels of the equipment attached to the E3/T3 interface comply with G.703.
	JP5 is set incorrectly	Correct the JP5 settings according to *Table 2-1*.
ELECTRICAL AIS indicator is ON	Attached equipment transmits "All 1s" string	Check the equipment attached to E3/T3 electrical interface, ensure that it transmits real data.
Optical ERR indicator is ON	No optical connection	Ensure that both transmit and receive fiber cables are properly connected to the local and remote units.
	The optical budget is low	Measure the optical loss over the fiber link and check that it meets the product specifications.
OPTICAL AIS is ON	The equipment attached to the remote unit transmits "All 1s" string	Check the equipment attached to the remote FOM-E3 or FOM-T3
TEST LOC indicator is ON	The unit is in the local loopback mode	Set the front panel TEST slide switch to NORM position.
TEST REM indicator is ON	The unit is in the remote loopback mode	Set the front panel TEST slide switch to NORM position.

4.4   Technical Support

Technical support for this product can be obtained from the local distributor from whom it was purchased.

For further information, please contact the RAD distributor nearest you or one of RAD's offices worldwide.

Customer Response Form

RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

Thank you for your assistance!

Manual Name: FOM-E3, FOM-T3 Ver. 1.0

Publication Number: 282-200-12/08

Please grade the manual according to the following factors:

	Excellent	*Good*	*Fair*	*Poor*	*Very Poor*
Installation instructions	❑	❑	❑	❑	❑
Operating instructions	❑	❑	❑	❑	❑
Manual organization	❑	❑	❑	❑	❑
Illustrations	❑	❑	❑	❑	❑
The manual as a whole	❑	❑	❑	❑	❑

What did you like about the manual?

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Error Report

Type of error(s) or problem(s):

- ☐ Incompatibility with product
- ☐ Difficulty in understanding text
- ☐ Regulatory information (Safety, Compliance, Warnings, etc.)
- ☐ Difficulty in finding needed information
- ☐ Missing information
- ☐ Illogical flow of information
- ☐ Style (spelling, grammar, references, etc.)
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- ☐ Other _____

Please list the exact page numbers with the error(s), detail the errors you found (information missing, unclear or inadequately explained, etc.) and attach the page to your fax, if necessary.

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You are:

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